WHAT IS CLAIMED IS:

1. A manufacturing method of a semiconductor device, comprising the steps of:

forming an insulating film above a semiconductor substrate;

forming, on said insulating film, a hard mask harder to polish than said insulating film upon chemical mechanical polishing and having a greater selective ratio with respect to said insulating film than a resist film under a prescribed etching condition;

forming a hole penetrating said hard mask and said insulating film to extend in a vertical direction with respect to a main surface of said semiconductor substrate;

forming a capacitor lower electrode along a side surface of said hole;

forming a capacitor dielectric film along a surface of said capacitor lower electrode; and

forming a capacitor upper electrode to contact a surface of said capacitor dielectric film.

2. A manufacturing method of a semiconductor device, comprising the steps of:

forming a first insulating film above a semiconductor substrate;

forming, on said first insulating film, a second insulating film different in composition from said first insulating film;

forming, on said second insulating film, a hard mask same in composition with said first insulating film and harder to polish than said second insulating film upon chemical mechanical polishing;

forming, on said hard mask, an etching stopper film having a greater selective ratio than said hard mask under a prescribed etching condition;

forming, by etching with said etching stopper film used as a mask, a hole penetrating said etching stopper film, said hard mask, said second insulating film and said first insulating film to extend in a vertical direction with respect to a main surface of said semiconductor substrate;

forming a film to be a capacitor lower electrode on a side surface of

said hole and an upper surface of said hard mask;

forming a buried film to bury said film to be the capacitor lower electrode;

forming the capacitor lower electrode by removing said buried film, said film to be the capacitor lower electrode and said etching stopper film by chemical mechanical polishing to expose said hard mask;

forming a capacitor dielectric film on a surface of said capacitor lower electrode; and

forming a capacitor upper electrode on a surface of said capacitor dielectric film.

3. A manufacturing method of a semiconductor device, comprising the steps of:

forming a first insulating film above a semiconductor substrate;

forming, on said first insulating film, a second insulating film different in composition from said first insulating film;

forming, on said second insulating film, a hard mask same in composition with said first insulating film and having a greater selective ratio with respect to said second insulating film than a resist film under a first prescribed etching condition;

forming, on said hard mask, an etching stopper film having a greater selective ratio than said hard mask under a second prescribed etching condition;

forming, by etching with said etching stopper film used as a mask, a hole penetrating said etching stopper film, said hard mask, said second insulating film and said first insulating film to extend in a vertical direction with respect to a main surface of said semiconductor substrate;

forming a film to be a capacitor lower electrode on a side surface of said hole and an upper surface of said hard mask;

forming a buried film to bury said film to be the capacitor lower electrode;

forming the capacitor lower electrode by removing said buried film, said film to be the capacitor lower electrode and said etching stopper film by

chemical mechanical polishing to expose said hard mask;

forming a capacitor dielectric film on a surface of said capacitor lower electrode; and

forming a capacitor upper electrode on a surface of said capacitor dielectric film.